CLAIMS

What is claimed is:

1.   A method of multi-channel MR spectroscopy (MRS) comprising the steps of:

5   simultaneously acquiring MR signals from multiple coils;

processing the MR signals individually to generate multiple sets of MRS results;

combining the multiple sets of MRS results to form a single superset of MRS results; and

10   generating and displaying a proton MRS absorption spectrum from the single superset of MRS results for clinical inspection.

2.   The method of claim 1 wherein the proton MRS absorption spectrum includes a single 2D proton MRS absorption spectrum.

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3.   The method of claim 1 wherein the step of processing includes steps of:

averaging individual frames of non-water suppressed reference data to obtain a non-water suppressed reference data set, r[n], for data from each coil;

averaging individual frames of water suppressed data to obtain a water

20   suppressed data set, s[n], for data from each coil;

applying a phase correction vector to each data set r[n] and s[n]; and

removing residual water signal from the water suppressed data set to generate a corrected MRS signal.

25   4.   The method of claim 3 wherein the steps of combining includes the steps of:

determining a maximum magnitude of the non-water suppressed data set for data from each coil;

from the maximum magnitude for data from each coil, determining a weighting factor for data from each coil;

applying a respective weighting factor to each set of MRS results based on the coil used to acquire the MR signals for the respective set of MRS results as weighted

5   sets of MRS results; and

summing the weighted sets of MRS results to form the single superset of MRS results.

5.   The method of claim 4 further comprising the step of normalizing the

10   weighting factors.

6.   The method of claim 3 further comprising the step of zero-padding time domain data of the corrected MRS signal and wherein the steps of generating and displaying a proton MRS absorption spectrum includes the step of generating a frequency

15   spectrum from the zero-padded time domain data.

7.   The method of claim 6 further comprising the step of displaying real portions of a complex result of the frequency spectrum representing the absorption spectrum for clinical inspection.

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8.   The method of claim 3 wherein the step of generating and displaying a single portion MRS absorption signal includes the step of applying a nonparametric filter bank technique to time domain data representing the corrected MRS signal to generate a 2D frequency spectrum versus damping.

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9.   The method of claim 8 wherein the nonparametric filter bank technique includes one of a Capon analysis and an APES analysis.

10.   The method of claim 3 further compromising the step of determining the phase vector c[n] by:

multiplying the non-water suppressed data set, r[n], by a scalar, $A_{zp}=r*[0]$;

determining a largest frequency component, ω_m, of the non-water

5   suppressed data set, s[n];

determining a number of phase cycles, ω_{lp}, in the non-water suppressed data set, s[n];

determining a phase spline smoothing factor $\phi_s[n]$, from an unwrapped phase of $r[n]e^{-i(\omega_m+\omega_{lp})n}$;

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generating a data windowing function, $\omega[n]$; and

multiplying $A_{zp} \cdot e^{-i(\omega_m+\omega_{lp})n+\phi_s(n)}$ and $\omega[n]$.

11.   The method of claim 10 further comprising the step of determining a

15   corrected non-water suppressed signal, $r[n]_{corrected} = c[n] \cdot r[n]$, and determining a corrected water suppressed signal, $s[n]_{corrected} = s[n] \cdot r[n]$.

12.   The method of claim 11 wherein the step of generating and displaying a single proton MRS absorption spectrum includes the steps multiplying $s_{corrected}[n]$ by a

20   scalar, a_{scale}, and subtracting r[n] from the product wherein a_{scale} includes a constant representing a ratio of largest magnitude of frequency components of the water suppressed and non-water suppressed data sets, s[n] and r[n], respectively.

13.   A magnetic resonance imaging (MRI) system having a plurality of

25   gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to a multi-receiver channel RF coil assembly to acquire MR images; and

a computer programmed to:

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acquire MR signals from multiple receiver channels;

process the MR signals from each receiver channel independently;

combine the processed MR signals from each receiver channel into a single composite set of MRS results; and

display a proton MRS absorption spectrum from the single composite set of MRS results.

14.   The MRI system of claim 13 wherein the proton MRS absorption spectrum includes a single composite 2D proton MRS absorption spectrum.

15.   The MRI system of claim 13 wherein the computer is further programmed to assign weight factors to the MR results from each coil before the MR results are combined.

16.   The MRI system of claim 15 wherein a set of MRS results is assigned a weight factor of zero if the acquired MR signal is determined to be weak as compared to other MR signals acquired.

17.   The MRI system of claim 15 wherein the computer is further programmed to normalize the weight factors.

18.   The MRI system of claim 13 wherein the computer is further programmed to apply a nonparametric filter bank technique to time domain data representing the corrected MRS signal to generate a frequency spectrum versus damping.

19.   The MRI system of claim 13 wherein the computer is further programmed to:

average individual frames of non-water suppressed reference data to obtain a non-water suppressed reference data set, r[n], for data from each coil;

average individual frames of water suppressed data to obtain a water suppressed data set, s[n], for data from each coil; and

apply a phase correction vector to each data set r[n] and s[n] to remove residual water signal from the water suppressed data set to generate a corrected MRS data

5   set for data from each coil.

20.   The MRI system of claim 13 wherein the computer is further programmed to:

determine a maximum magnitude of the non-water suppressed data set for

10   data from each coil;

determine a weighting factor for each coil from the maximum magnitude for data from each coil;

apply the weighting factor to each set of MRS results based on the coil used to acquire the respective set of MRS results as weighted sets of MRS results; and

15   combine the weighted sets of MRS results to form the single superset of MRS results.

21.   A computer readable storage medium having stored thereon a computer program to generate a single composite MRS spectrum from MR data acquired from

20   multiple coil elements that comprises a set of instructions, which when executed by a computer, causes the computer to:

acquire MR data from multiple coil elements independently;

combine the processed MR data into a single composite set of MRS results; and

25   display a single MRS absorption spectrum as a function of the combined set of MRS results acquired from the multiple coil elements.

22.   The computer program of claim 21 further comprising instructions to process the MR data from multiple coil elements independently.

23. The computer program of claim 22 further comprising instructions to assign weight factors to the MRS results from each coil before the processed MRS results are combined.

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24. The computer program of claim 23 having further instructions to assign a weight factor of zero if an acquired MR signal is determined to be weak when compared to other acquired MR signals.

10   25. The computer program of claim 23 having further instructions to preferentially weight each data set based on data acquisition time.

26. The computer program of claim 21 wherein the proton MRS absorption spectrum includes a single 2D proton MRS absorption spectrum with both frequency and 15   damping factors represented.

27. The computer program of claim 21 having further instructions to apply a non-parametric filter bank technique to time domain data representing the corrected MRS signal to generate a frequency spectrum versus damping.

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